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DUANE MORRIS LLP  
IP DEPARTMENT (TSMC)  
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EXAMINER

RUGGLES, JOHN S

ART UNIT PAPER NUMBER

1756

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/05/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

## Office Action Summary

**Application No.**

10/810,385

**Applicant(s)**

LU ET AL.

**Examiner**

John Ruggles

**Art Unit**

1756

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 11/30/07.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) none is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11/30/07 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)          | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Response to Amendment***

In the current 11/30/06 amendment submission listing of claims, claims 1, 4, 6, 8-9, 11, 14-16, and 18-23 are currently amended and claims 2-3, 5, 7, 10, 12-13, and 17 are original.

The previous drawings objections are withdrawn in view of the current faxed replacement drawings sheets for Figures 1-3, 5A-5B, and 8A-8B that would be acceptable subject to the corrections indicated below.

The previous specifically exemplified objections to the specification numbered (1)-(4) are withdrawn in view of the current specification amendments and accompanying remarks. However, further objections to the specification are exemplified below.

The previous objections of claims 1-23 are withdrawn in view of the current claim amendments and accompanying remarks.

Most of the previous rejections of claims 1-23 under the second paragraph of 35 U.S.C. 112 numbered (1)-(3) are withdrawn in view of the current claim amendments and accompanying remarks. However, a portion of the previous rejection numbered (3) (a) is maintained below as necessitated by the current amendment.

The previous rejection under 35 U.S.C. 103(a) is withdrawn in view of Applicants' admission in the current amendment submission on page 14 of 15 that Lin US 2004/0191642, which corresponds to US 6,982,134 was commonly owned by the same Assignee, Taiwan Semiconductor Manufacturing Co., LTD, as the instant application at the time of the instant invention. However, this admission has also necessitated a new nonstatutory obviousness-type double patenting (ODP) rejection as set forth below.

The examiner called Attorney Mark Marcelli to request a terminal disclaimer (TD) that would have obviated the ODP rejection set forth below. However, plural attempts did not result in a TD being filed, necessitating the ODP rejection in this Office action.

### ***Drawings***

The previous drawings objections are withdrawn in view of the current faxed replacement drawings sheets for Figures 1-3, 5A-5B, and 8A-8B that would be acceptable subject to correction of the following: (1) these replacement drawings are informal in their present form and (2) at least some of the lines in Figures 1, 5A-5B, and 8A-8B are not clear, uniformly thick, nor well-defined enough to permit adequate reproduction (see e.g., 37 CFR § 1.84(l), etc.). Applicants are advised to employ the services of a competent patent draftsman outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. Corrected formal drawings for these figures are required in reply to this Office action, in order to avoid abandonment of this application. This requirement for corrected drawings will not be held in abeyance.

### ***Specification***

The previous specifically exemplified objections to the specification numbered (1)-(4) are withdrawn in view of the current specification amendments and accompanying remarks. However, further objections to the specification are exemplified below.

The disclosure is objected to at least because of the following informalities: (5) at [0005] line 2, "defects may be cause even more problems" should be changed to --defects may [[be]] cause even more problems-- and (6) Applicants should also correct all other applicable errors of

Art Unit: 1756

which they become aware. It is further noted that the abstract of the disclosure does not include some essential aspects of the currently amended claims.

Appropriate correction is required.

***Claim Objections***

The previous objections of claims 1-23 are withdrawn in view of the current claim amendments and accompanying remarks.

***Claim Rejections - 35 USC § 112***

Most of the previous rejections of claims 1-23 under the second paragraph of 35 U.S.C. 112 numbered (1)-(3) are withdrawn in view of the current claim amendments and accompanying remarks. However, a portion of the previous rejection numbered (3) (a) is maintained below as necessitated by the current amendment.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 6-7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

(3) (a) In claim 6 line 3, "the one or more grating areas" lacks proper antecedent basis and should be corrected to --the one or more artificial grating areas--, in order to better correspond with this latter phrase in claim 6 line 2. Claim 7 depends from claim 6.

***Claim Rejections - 35 USC § 103***

The previous rejection under 35 U.S.C. 103(a) is withdrawn in view of Applicants' admission in the current amendment submission on page 14 of 15 that Lin US 2004/0191642,

Art Unit: 1756

which corresponds to US 6,982,134 was commonly owned by the same Assignee, Taiwan Semiconductor Manufacturing Co., LTD, as the instant application at the time of the instant invention. However, this admission has also necessitated a new nonstatutory obviousness-type double patenting (ODP) rejection as set forth below.

### ***Double Patenting***

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-23 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-13 of U.S. Patent No. 6,982,134 (Lin '134) in view of either Tazawa et al. (US 5,282,140), Iwasaki et al. (US 2002/0058188) or Smith (US 2003/0207184), and further in view of Tejnil (US 2004/0234869) and Lalanne et al. (The Optical Properties of Artificial Media Structured at a Subwavelength Scale [Document CH in the 3/26/04 IDS, Pages 1-11]).

The conflicting claims of the Lin '134 patent are not identical to the instant claims, because the Lin '134 patent claims do not specifically teach: */1/* determining topographical information about the mask defect; */2/* determining mask repair specifications based on an optical simulation using the topographical information about the mask defect; and */3/* that the areas etched into the mask substrate to repair the defect form one or more artificial grating areas so that each grating area is no wider than the exposure wavelength to change the effective refractive index of a localized area encompassing the defect.

However, three-dimensional (3-D) topological or topographical information analysis and optical simulation of a workpiece area that includes defining a numerical mesh over the workpiece surface (e.g., encompassing a surface defect on a shadow mask to determine repair specifications, etc.) before deposition or etching (e.g., to repair the surface defect, etc.) related to lithography for manufacturing integrated circuits has been known for some time in the art of semiconductor device manufacturing as having the benefits of reducing design times, experimentation, and manufacturing costs (as taught by Tazawa et al., abstract, c1/L8-28). Similarly, Iwasaki et al. teach (3-D, topographical) optical simulation of a (single trench) Levenson phase shift mask (alt-PSM) having PS trench(es) in the substrate for successfully directly analyzing defect(s) by comparing transmission of incident light intensities between the PS and non-PS regions of the PSM (e.g., using a CCD camera, etc.) before repairing or correcting the defect (title, abstract, [0103]). Also, Smith teaches a method and apparatus for correcting or repairing PS defects (e.g., bump defects, etc.) in an alt-PSM by scanning for location of defects, 3-D analysis of the defects, and focused ion beam (FIB) treatment controlled by an etch map (or repair specifications) generated based on the 3-D results to eliminate the PS

Art Unit: 1756

defects (title, abstract, front page Figure 12, etc.). As shown in Figures 9, 12, and 13, the alt-PSM 120 includes a mask substrate of silica, quartz, calcium fluoride ( $\text{CaF}_2$ , which is understood to be suitable for either 193nm, 157nm, or even shorter exposure wavelengths), or other well known suitable transparent material [0037]. The 3-D analysis of the mask defect can be carried out, for example, by an atomic force microscope (AFM) [0041] (*[1]*, *[2]*).

Tejnil teaches that closely spaced sub-wavelength width structures or grooves (in a grating pattern) etched into a transparent mask substrate at a step height or depth to produce an effective PS (of e.g.,  $60^\circ$  to  $120^\circ$ , etc.) that is different from the PS (of e.g.,  $180^\circ$ , etc.) normally associated with substrate trenches or grooves having a width greater than the wavelength of exposure light, but still having the same step height or depth (abstract, [0015]). As shown in Figure 5, the sub-wavelength etched features 400 in the mask substrate may be significantly smaller than the wavelength ( $\lambda$ ) of incident light (e.g.,  $x_1 \approx x_2 < \sim \lambda/2$ , etc. [0015]). An exemplary exposure wavelength is 193nm [0019]-[0020]. This sub-wavelength grating pattern of grooves in the mask substrate producing an effective PS of  $60^\circ$  to  $120^\circ$  can be etched at the same depth as wider grooves producing a PS of  $180^\circ$  using fewer processing steps and at a lower cost than by separately patterning and etching features or steps in the mask substrate to depths corresponding to a PS of  $60^\circ$  to  $120^\circ$  [0021].

Lalanne et al. teach that introduction of very fine structures into a standard transparent material (e.g., as a transparent base or substrate of a known refractive index having a series of holes, etc.) with a scale that is substantially smaller than the wavelength of light incident on the transparent substrate material (having sub-wavelength holes or grooves), the very fine sub-wavelength structures will not be resolved by the incident light transmitted through the



Art Unit: 1756

transparent substrate, but instead the light “sees” a composite material having optical properties (such as an effective refractive index) between those of air and those of the solid transparent substrate material. By varying the fraction of material that is removed or etched to form the sub-wavelength holes or grooves, it is possible to control the effective refractive index of the transparent substrate material (page 1, Introduction section, right col.). A regularly spaced series of sub-wavelength parallel grooves would form a periodic grating called an “artificial” media (page 2, left col.). Computation plays a crucial role in the analysis and design of periodic artificial media (such as an artificial grating of sub-wavelength grooves in a transparent substrate), with Fourier expansion techniques being applicable to any periodic microgeometry (page 3, right col.). Sub-wavelength gratings are characterized by fill factor ( $f$ , which represents the fraction of high-index transparent substrate material in the remainder of low-index air-filled grooves in the overall grating area, page 3, left col.) and period or spacing (page 4, left col. to page 5, right col.). By controlling the structure of the sub-wavelength gratings or other structures in a transparent substrate, the resulting range of optical properties (e.g., effective refractive index, etc.) can be extended for increased optical design possibilities (page 9, Conclusion section, right col. */3/*).

It would have been obvious to one of ordinary skill in the art at the time of the invention in the method of repairing a mask substrate void or pit defect by etching steps at desired PS depths or step heights (having PS intervals of e.g., 45°, 90°, 135°, 180°, etc.) for uniform exposure of a photoresist layer through the repaired mask (as taught by Lin '134) to include 3-D topological or topographical information analysis and optical simulation of a mask defect before etching (e.g., to repair the surface defect, etc.), because 3-D topographical information analysis

Art Unit: 1756

and optical simulation of workpiece surfaces (e.g., to detect a surface defect, etc.) related to lithography for manufacturing integrated circuits have been known for some time as having the benefits of reducing design times, experimentation, and manufacturing costs (as taught by either Tazawa et al., Iwasaki et al., or Smith [1], [2]). It would also have been obvious to alternatively form sub-wavelength artificial grating areas etched in the mask substrate adjacent to the void or pit defect so that the etched artificial grating areas have desired effective PS intervals (of e.g., 45°, 60° to 120°, etc., as taught by Tejnil) and also exhibit a desired effective refractive index, because (1) this grating pattern of sub-wavelength etched grooves in the mask substrate can be etched at the same depth as wider grooves producing a PS of 180° using fewer processing steps and at a lower cost than by separately patterning and etching features or steps in the mask substrate to depths normally corresponding to the desired PS intervals (of e.g., 45°, 60° to 120°, etc., as taught by Tejnil); and also because controlling the structure of the sub-wavelength grating pattern in the mask substrate extends the resulting range of optical properties (e.g., effective refractive index, etc.) for increased optical design possibilities (as taught by Lalanne et al. [3]).

### ***Response to Arguments***

Applicants' arguments with respect to claims 1-23 have been considered, but they are moot in view of the new ground(s) of rejection, which are necessitated by the current amendment and the accompanying remarks (including Applicants' admission on page 14 of 15 that Lin US 2004/0191642, which corresponds to US 6,982,134 was commonly owned by the same Assignee, Taiwan Semiconductor Manufacturing Co., LTD, as the instant application at the time of the instant invention).

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

jsr



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